

Report on the Pennatulida of the Mergui Archipelago, collected for the Trustees of the Indian Museum, Calcutta, by Dr. John Anderson, F.R.S., Superintendent of the Museum. By Prof. A. MILNES MARSHALL, M.A., M.D., F.R.S., and G. HERBERT FOWLER, B.A., Ph.D. (Communicated by Dr. JOHN ANDERSON, F.R.S., F.L.S.)

[Read 3rd November, 1887.]

(PLATES XXII. & XXIII.)

THE collection of Pennatulida entrusted to us for examination and report is an interesting one, for though it only includes representatives of five genera and ten species, of these latter two are new, of two others only single specimens have hitherto been described, and three others are as yet very imperfectly known.

The zoological position of the genera and species is shown in the following Table, abridged from the classification proposed by Kölliker in his Report on the Pennatulida collected by H.M.S. 'Challenger'\*. The genera and species represented in the Mergui collection are alone mentioned:—

Order PENNATULIDA.

Section I. PENNATULIDÆ.

Subsection 1. *Penniformes*.

Family i. PTEROEIDIDÆ.

*Pteroeides elegans*, *Herklots*.

*Pteroeides Lacazii*, *Kölliker*.

*Pteroeides chinense*, *Herklots*.

*Pteroeides Esperii*, *Herklots*.

Family ii. PENNATULIDÆ.

Subsection 2. *Virgulariæ*.

Family i. VIRGULARIIDÆ.

*Virgularia Rumphii*, *Kölliker*.

*Virgularia prolifera*, *sp. nov.*

Family ii. STYLATULIDÆ.

Section II. SPICATÆ.

Section III. RENILLEÆ.

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\* Kölliker, Report on the Pennatulida, Zool. Chall. Exp. part ii. (1880), pp. 33-35.

## Section IV. VERETILLIÆ.

## Family i. CAVERNULARIIDÆ.

Cavernularia obesa, *Valenciennes*.

## Family ii. LITUARIIDÆ.

Lituaria phalloides, *Pallas*.Policella manillensis, *Kölliker*.Policella tenuis, *sp. nov.*

The specimens, which are in excellent condition, were obtained in shallow water; and a large proportion of them from mud-flats exposed at spring-tides.

In the following descriptions we have employed the term "ray," as the equivalent of the German "Strahlen," to indicate the bars of calcareous spicules which traverse the leaves of many Pennatulida; and have used the word "spine" to designate the ends of the rays which project freely beyond the margin of the leaf.

In describing the leaves, we have used the term "ventral border" to indicate the free ventral edge of the leaf, from the attachment to the rachis to the tip of the leaf. By the "height" of a leaf we mean the greatest measurement across the leaf at right angles to the ventral border. All measurements are given in millimetres.

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*Description of the Specimens.*

## Section I. PENNATULIÆ.

Subsection 1. *Penniformes*.

## Family i. PTEROEIDIDÆ.

Genus PTEROEIDES, *Herklots*.

PTEROEIDES ELEGANS, *Herklots*. (Plate XXII. figs. 1 & 2.)

A single specimen of this species was obtained from the Andaman Islands.

The species was established by Herklots\*, in 1858, on a single specimen in the Leyden Museum, believed to come from the Indian Ocean. A fuller description of this specimen, the only one recorded as yet, was given by Kölliker† in 1872.

The colony (fig. 1) is long and slender; the feather longer than the stalk, and the rachis and stalk of nearly equal and

\* Herklots, 'Notices pour servir à l'étude des Polypiers Nageurs ou Pennatulides' (Amsterdam, 1858), pp. 21, 22, and pl. vi. fig. 2.

† Kölliker, Anatomisch-systematische Beschreibung der Alcyonarien: I. Die Pennatuliden (Frankfurt a. M., 1872), pp. 57, 58.

uniform diameter. The general colour is brownish yellow mottled with purplish spots, especially near the edge of the leaves. The axis extends the whole length of the colony, is moderately flexible, and hooked at both ends.

The top of the rachis projects about 4 millim. beyond the uppermost leaf, and bears on its dorsal surface a longitudinal row of four small rudimentary polypes, which probably represent the dorsal zooid stripe of other species.

The leaves are small, and directed upwards, overlapping one another like tiles. The largest ones are a little above the middle of the rachis: the uppermost two or three pairs are small and very stiff: in the lower half of the rachis the leaves gradually diminish in size, but retain their lateral position. The leaves are fan-shaped, the free dorsal border sometimes nearly straight as though truncated, sometimes irregularly notched. The rays are broad, 11 in number as a rule, and very conspicuous on the under surfaces of the leaves; their distal ends project as short irregularly placed spines. The polypes or autozooids are small, and arranged in 4 or 5 rows along the edge of each leaf and on both surfaces. There is a prominent, sharply defined basal zooid plate, which does not touch the zone of the autozooids, and is yellow in colour. There is no ventral zooid stripe. Small calcareous needles are present in considerable numbers in the leaves, round the bases of the autozooids, but there are no spicules in the cutis of either the rachis or stalk.

The principal dimensions of the specimen are given below; for the sake of comparison the measurements as recorded by Kölliker of the specimen in the Leyden Museum are also given.

	Andaman Island specimen.	Specimen in Leyden Museum.
Length of colony .....	165	203
Length of stalk .....	57	38
Length of feather .....	108	154
Width of feather .....	10	10-12
Diam. of rachis, greatest .....	5	6.5
Diam. of stalk, average .....	5.5	8
Number of leaves .....	{ right side 34 + 8 left side 39 + 13	{ right side 40 + 6 left side 43 + 8
Height of largest leaf .....	8	
Ventral border of largest leaf .....	8	11
Base of attachment of largest leaf .....	4	5
Number of rays.....	11-12	
Length of spines .....	0 to .5	

PTEROEIDES LACAZII, *Kölliker*. (Plate XXII. figs. 3-6.)

Of this extremely variable species there are 34 specimens in the collection; 22 from the Andaman Islands, 12 from the Mergui Archipelago. These differ a good deal among themselves, but fall into two well-marked divisions, which we propose to describe as varieties *a* and *β* respectively.

PT. LACAZII, var. *a*. (Plate XXII. fig. 3.)

This group, which includes 21 of the specimens from the Andaman Islands, is characterized by the following points:—

The feather is narrower than in variety *β*, and is of nearly uniform width along the greater part of its length. The leaves are more falciform in shape; the rays are less numerous, but stronger and more regularly arranged; the spines are longer, and the margin of the leaf more deeply notched.

The principal dimensions of this variety are as follows:—

	<i>a</i> .	<i>b</i> .	<i>c</i> .	<i>d</i> .
Length of colony .....	150	237	174	163
Length of stalk .....	75	97	78	87
Length of feather .....	75	140	96	76
Width of feather .....	48	47	37	33
Width of rachis, ventral surface...	17·5	16	10·5	11
Diam. of stalk, average .....	12	12	10	9
Number of leaves .....	40 +4 rud.	47 +4 rud.	39 +7 rud.	41 +7 rud.
Height of largest leaf .....	13	20	11	10
Ventral border of largest leaf .....	19	18	17	14
Base of attachment of largest leaf	9	9	4	4
Number of rays.....	15	16	13	11-12
Length of spines .....	2-2·5	1·5-3	0·7-2	1·5-3

PT. LACAZII, var. *β*. (Plate XXII. figs. 4-6.)

The second variety includes the 12 specimens from the Mergui Archipelago, and one from the Andaman Islands.

In these the feather is oval in shape, being widest at or slightly above its middle. The leaves are fan-shaped, and softer than in variety *a*. The rays are rather more numerous, but hardly project beyond the margin of the leaf, which is almost entire, and fringed with short spicules. The stalk is markedly thicker than in variety *a*.

The principal dimensions of this variety are as follows:—

	<i>a.</i>	<i>b.</i>	<i>c.</i>
Length of colony .....	215	160	245
Length of stalk .....	83	73	105
Length of feather .....	132	87	140
Width of feather .....	60	52	65
Width of rachis, ventral surface...	14	14	20
Diam. of stalk, average.....	13	12	17
Number of leaves .....	41 + rud.	{ 25 + 5 (topmost leaves lost)	} 39 + 5 rud.
Height of largest leaf .....	20	19	24
Ventral border of largest leaf .....	28.5	21	26
Base of attachment of largest leaf	5	9	6
Number of rays.....	20	18-20	18-20
Length of spines .....	0.5-1.5	0.5-1	0.3-1

Several of the specimens are mutilated, apparently by the leaves being eaten off. This occurs far more commonly in the lower than in the upper half of the feather, the lower leaves being in some cases stripped off almost to their bases. This may perhaps point to the injury being inflicted by some animal crawling on the sea-bottom.

In three specimens of variety *a* and one of *β* the lower end of the axis, ensheathed in a membranous covering, projects freely, for a distance of 9 to 24 millim. in different forms, from an aperture at the lower end of the stalk.

Inasmuch as the axis extends to the extreme top of the rachis in some of these specimens, the projection of its lower end must be due to shrinking upwards of the stalk, not to shifting downwards of the axis; and has probably been caused by contraction, due to the spirit in which the specimens are preserved. The terminal aperture has smooth rounded lips, and is formed by enlargement of the small pore which is present during life.

One specimen of variety *β* (fig. 5) is noteworthy, on account of the formation of additional leaves on the ventral surface of the rachis. Along the right side there is an incomplete longitudinal row of single polypes, about 3-4 millim. to the inner side of the bases of the leaves; the largest polypes having a length of 10 millim.

On the left side there are, about the middle of the rachis, two large, irregular leaves with well-developed zooid plates; the larger of the leaves being 27 millim. long and 12 wide at the base. Other smaller leaves, or single polypes, occur distributed

in imperfect longitudinal rows along the middle third of the rachis.

In most specimens of both varieties, small crabs are found lying between the leaves; these have no uniformity of position, are quite unattached, and cause no modification in either the leaves or rachis. Small Copepoda also occur in considerable numbers in the same situation.

PTEROEIDES CHINENSE, *Herklots*. (Plates XXII. & XXIII. figs. 7-11.)

We have referred to this species ten specimens from the Andaman Islands.

The species was established by Herklots in 1863\*, and described more fully by Kölliker in 1872†, but, so far as we can ascertain, has not been noticed by other authors.

Kölliker's account is based on four specimens; one in the Leyden Museum from Amoy, in China, two in the Hamburg Museum from the Indian Ocean, and one in the Copenhagen Museum from Japan. He includes also in the species, as a variety *macracantha*, a single specimen in the Copenhagen Museum, from Japan, in which the feather is much wider proportionately to its length, the leaves larger, the rays less numerous and stronger, and the spines longer.

All our specimens agree in the following points:—The colonies are of medium size, averaging about 100 millim. in length; the rachis is longer than the stalk, but never twice its length; the feather is about as wide as it is long, in some cases wider, and its greatest width is below its middle; the stalk is thick, straight and firm, and there is a slight swelling at its junction with the rachis; the axis is slender and flexible, extending almost to the top of the rachis, and rather more than halfway down the stalk. The colour is very variable; the ground-colour both of feather and stalk is usually an orange-yellow, mottled with purplish spots. The autozooids are always purplish in colour.

The leaves vary in thickness, and are about 30 in number on each side; in the upper half of the feather they overlap and conceal the dorsal surface of the rachis. The lowermost 4 to 6 leaves on both sides are irregular in shape, usually spatulate, and approach one another on the ventral surface of the rachis; sometimes they

\* Herklots, *Nederlandsch Tijdschrift voor de Dierkunde*, 1863, i. pp. 31-34.

† Kölliker, *Anatomisch-systematische Beschreibung der Alcyonarien: I. Die Pennatuliden* (Frankfurt, 1872), pp. 87-88, and Taf. v. figs 40, 41.

are directed across the ventral surface, and they may overlap (fig. 8). In the mature leaves the rays are well developed, from 16 to 22 in number, and project as very obvious spines. The autozooids are arranged in 3 or 4 rows along the margins of both surfaces of the leaf, and the mouths of the cells are pigmented. There is a well-developed marginal zooid plate present in all cases, usually markedly dentate along its distal margin, and consisting of small, usually colourless siphonozooids. Larger siphonozooids, usually pigmented, are irregularly distributed over the basal portion of the zooid plate, and also over the upper surface of the leaf; a well-marked ventral zooid stripe is present at the base of each leaf (fig. 8). The dorsal zooid stripe of the rachis is short, does not extend below the 3rd or 4th pair of leaves, and consists of 2 or 3 rows of siphonozooids.

Our specimens fall into two well-marked groups, which we propose to describe as varieties.

*PT. CHINENSE*, var. *a*. (Plate XXII, figs. 7-9.)

Of this form there are nine specimens, all from the Andaman Islands.

The general ground-colour is brownish yellow; the stalk is mottled with purplish spots; the leaves are yellow, with the polype-mouths and the larger siphonozooids purple. This general yellow colour dotted with purple spots is very characteristic of all ten specimens.

The feather is oviform to triangular in outline, and widest close to its lower end. The rachis is wide, especially near its lower end; the stalk is shorter than the rachis, and thick. The lowermost leaves are markedly spatulate, and those of the two sides may overlap one another on the ventral surface of the rachis (fig. 8).

The mature leaves (fig. 9) are of moderate thickness, and are fan-shaped, the ventral border being nearly straight and the tip very slightly hooked. The rays are 16 to 22 in number; they are not very conspicuous on the under surface of the leaf, but project beyond its edge as stout marginal spines arranged somewhat irregularly, and obviously consisting of bundles of smaller spicules.

The zooid plate (fig. 9) is large; it extends along two thirds of the length of the ventral border of the leaf, and is continued along the rays so as to present a strongly toothed margin. The ventral zooid stripe is well developed, and present in all the

leaves (fig. 8). The dorsal zooid stripe of the rachis is short, consisting of 2 to 4 rows of siphonozooids placed opposite the uppermost 3 pairs of leaves.

The following table gives the principal dimensions of three specimens of this variety. Of these, the first one (*a*) is the most typical one, *b* and *c* being more divergent forms, which in some respects approximate to the second variety ( $\beta$ ).

	<i>a.</i>	<i>b.</i>	<i>c.</i>
Length of colony .....	108	107	93
Length of stalk.....	40	51	40
Length of feather .....	68	56	53
Width of feather .....	65	89	51
Width of rachis, ventral surface...	23	31	18
Distance apart of lowest leaves ...	11	10	12
Diam. of stalk, average .....	15	15	17
Number of leaves .....	29 +4 rud.	27 +5 rud.	27 +4 rud.
Height of largest leaf .....	14	22	13
Ventral border of largest leaf.....	22	28	21
Base of attachment of largest leaf	7	11	8
Number of rays.....	20	18-22	16-20
Length of spines .....	2-2.5	2-3	2-2.5

PT. CHINENSE, var.  $\beta$ . (Plate XXIII. figs. 10 & 11.)

A single specimen of this form was obtained from the Mergui Archipelago. In general appearance it agrees fairly closely with var.  $\alpha$ , from which it differs in the following points:—

The colony is almost uniformly purple in colour; the leaves brown at the base, with a broad purple marginal band corresponding to the zone of autozooids. The feather is markedly wider than it is long. The leaves are thick and fleshy, especially at their margins, and are only slightly notched between the spines, and the spines are shorter.

It is quite possible that these differences may be due to local circumstances.

The principal dimensions of this variety are as follows:—

Length of colony .....	98 mm.
Length of stalk .....	44
Length of feather .....	54
Width of feather .....	72
Width of rachis, ventral surface .....	21
Distance apart of lowest leaves .....	9.5



Diam. of stalk, average .....	16 mm.
Number of leaves .....	21 + 6 rud.
Height of largest leaf .....	17
Ventral border of largest leaf .....	26
Base of attachment of largest leaf ....	9·5
Number of rays .....	19-21
Length of spines .....	2

PTEROEIDES ESPERI, *Herklots*. (Plate XXIII. figs. 12-15.)

To this form we refer eleven specimens, all from the Mergui Archipelago. They differ a good deal among themselves in colour, and in general appearance and proportions, but we have found it impossible to separate them.

The general characters agree with those given by K lliker \*, so that there is no need to describe them in detail. Some of the specimens agree in many points with *Pteroeides chinense*, and it is not easy to find reliable differences between the two species. In *Pt. Esperii*, however, the length of the rachis is greater relatively to its width, and the feather is longer relatively to the stalk. The lowermost leaves do not approach so closely on the ventral surface of the rachis, and are not spatulate in form. The leaves are more sickle-shaped, the rays fewer in number, 13-16, and more conspicuous; the spines are more pointed and slender, and the margins of the leaves more deeply notched between them.

Our specimens fall into two groups, which we propose to speak of as varieties  $\alpha$  and  $\beta$ .

PT. ESPERI, var.  $\alpha$ . (Plate XXIII. figs. 12, 13.)

In this variety, of which there are eight specimens, the leaves are markedly sickle-shaped, and the rays very conspicuous on their under surface; the zooid plate is smaller than in *P. chinense*, does not extend so far along the ventral border of the leaf, is very slightly dentate at its margin, and is very often brown in colour. The principal measurements of these specimens are as follows,  $\alpha$  being a typical one,  $b$  and  $c$  more extreme forms:—

\* K lliker, *Alcyonarien*, pp. 108-113.

	<i>a.</i>	<i>b.</i>	<i>c.</i>
Length of colony.....	88	90	82
Length of stalk .....	26	34	29
Length of feather .....	62	56	53
Width of feather .....	53	53	45
Width of rachis, ventral surface .....	15	14	10
Distance apart of lowest leaves .....	10	9	9
Diam. of stalk, average .....	13	10	12
Number of leaves.....	21+5 rud.	24+7 rud.	21+4 rud.
Height of largest leaf.....	13	14	10
Ventral border of largest leaf .....	24	28	21
Base of attachment of largest leaf...	5	5	4.5
Number of rays .....	16	16	13
Length of spines .....	2.5-4	2-2.5	2.5

*Pt. Esperii*, var.  $\beta$ . (Plate XXIII. figs. 14, 15.)

The three specimens of this form are chiefly characterized by the soft flabby condition of the rachis and leaves, the latter being thin, almost membranous, and twisted about in a very irregular fashion, as shown in fig. 14. It is very possible, however, that this flabbiness may be, at least in part, an accidental or temporary condition, and it would be well not to attach much weight to it. In other respects these specimens are in many ways intermediate between the preceding variety and *Pt. chinense*. In relative proportions of feather and stalk, and of length and width of the feather, as also in the number of rays in the leaves, and the marked notching of their margin, they closely resemble *Pt. Esperii*, var.  $\alpha$ ; while, on the other hand, they differ from this, and approach *Pteroeides chinense*, in the shape of the leaves, and in the size, shape, and other characters of the zooid plate. They differ from both these forms in the much greater extent to which the dorsal surface of the rachis is exposed, but this is very possibly to be associated with the generally flabby condition of the specimens. The principal measurements of variety  $\beta$  are as follows:—

Length of colony .....	120 mm.
Length of stalk .....	38
Length of feather .....	84
Width of feather .....	57
Width of rachis, ventral surface .....	13
Distance apart of lowest leaves.....	5
Diam. of stalk, average .....	15
Number of leaves .....	23+5 rud.

Height of largest leaf .....	13 mm.
Ventral border of largest leaf .....	25
Base of attachment of largest leaf ...	5
Number of rays .....	13
Length of spines.....	2·5-3·5

Subsection 2. *Virgulariæ.*

## Family i. VIRGULARIIDÆ.

Genus VIRGULARIA, *Lamarck.*VIRGULARIA RUMPHII, *Kölliker.*

Of this fine species there are three specimens, two of which are entire, while the third has been cut off, apparently by the dredge, at the junction of stalk and rachis. In consequence of their great length, all three have been broken in order to allow of their preservation in tubes of ordinary size.

Kölliker named the species from a single specimen, from Amboina, in the Berlin Museum\*; we have met with no other account of it, and have therefore thought it well to describe our specimens in some detail.

The colonies, which are very long, up to 900 millim., are slender, rod-like, and of nearly uniform diameter along their entire length. The stalk is long and cylindrical, and ends below in a dilated vesicle, which is fairly obvious in the largest specimen, though contracted and inconspicuous in the other. In this, as in other species of Pennatulida, the presence or absence of a terminal vesicle to the stalk depends very largely on the degree of contraction of the specimen, and is a character of no practical value in classification.

The axis is stout, brittle, and oval in transverse section. Its upper end is abruptly truncated, and projects freely for some millimetres above the fleshy part of the rachis. This projection occurs during life, as in one specimen a couple of barnacles were adherent to the exposed part of the axis. At the lower end of the rachis the axis tapers rapidly; it enters the stalk, but only extends a short distance along it, ending in a slender hooked extremity. The surface of the axis along the whole length of the rachis is sculptured by irregularly arranged and intercrossing grooves.

The fleshy part of the rachis along the greater part of its

\* Kölliker, *Aleyonarien*, pp. 202-205, and pl. xiii. figs. 123-124.

length is very thin, forming little more than a membranous sheath to the axis, from which the leaves arise. At the lower end of the rachis there is on either side a longitudinal row of single small zooids, about 50 millim. in length (*cf.* fig. 16), above which the leaves commence. These are, for some distance, very small and very close together, but as they pass upwards become gradually larger and further apart. Even in the lowest leaves the component polypes are indicated by slight notchings of the margins. The largest leaves occur about the junction of the middle and upper thirds of the rachis, above which point they diminish slightly in size. At the upper end the leaves are small, shrivelled, and closely approximated to one another, appearing as mere wrinklings of the surface.

The leaves, even the largest ones, are of small size, and along the lower half of the rachis are little more than transverse ridges. Each leaf consists of 40 to 42 polypes arranged in a single row, but slightly alternating in the largest leaves, owing to displacement from mutual pressure. The ventral border of the leaf is concave, and is continued as a ridge on to the ventral surface of the rachis; in this ridge and the adjacent part of the rachis there is a very obvious network of branching canals, as described and figured by Kölliker\*. The siphonozooids are arranged in transverse rows at the bases of the leaves, the number of zooids in each row being about the same as that of the polypes in the corresponding leaf.

As in other species of *Virgularia*, the genital products are contained in the lower immature leaves. Of the three specimens, two are female and one male.

Considerable quantities of sand occur between the leaves closely adherent to the rachis, especially in its lower half. This derives some interest in consequence of the statement made by Rumphius †, that the allied species, *V. juncea*, which lives in very shallow water, has the habit of retracting almost completely into the sand at low water or when disturbed.

The principal measurements of the three specimens are as follows, the corresponding dimensions as given by Kölliker ‡ of the specimen in the Berlin Museum being added for comparison:—

\* Kölliker, *op. cit.* pl. xiii. fig. 123

† Rumphius, *D'Amboinsche Rariteitkamer* (Amsterdam, 1705), pp. 43–44.

‡ Kölliker, *op. cit.* p. 205.

	a.	b.	c.	Specimen from Amboina, in Berlin Museum.
Total length of colony.....	598	775	945	523
Length of stalk .....	Absent.	200	290	101
Length of rachis .....	585	568	635	422
Length of axis exposed above upper end of rachis.....	13	7	20	.....
Length of lateral zooid stripe...	42	65	42	24
Length of rachis with immature leaves.....	280	260	330	215
Length of rachis with developed leaves.....	263	243	283	183
Diam. of rachis { lower half ...	4.5	5	4	.....
{ upper half ...	4	3.5	3.5	.....
Diam. of stalk .....	Absent.	7	5	8
Diam. of terminal vesicle .....	Absent.	8.5	Inconspicuous.	14
Number of immature leaves ...	450 circa.	450 circa.	500 circa.	439 circa.
Number of developed leaves ...	110 circa.	85 circa.	100 circa.	76
Number of small leaves at top of rachis .....	35	18	26	8
Number of polypes per leaf ...	40	42	42	40-44
Height of leaf .....	2.5	2	1.5	3-3.5
Greatest distance apart of leaves	3.5	3	3.2	.....
Diam. of axis .....	3.7×3	3×2.5	4×3	3×2.7

*VIRGULARIA PROLIFERA*, sp. nov. (Plate XXIII. figs. 16, 17.)

Colony slender, rod-like, dark brown or black in colour\*. Stalk short, with a very obvious terminal vesicle, often inconspicuous from contraction, separated by a constriction from the rachis. A well-marked lateral zooid stripe at each side of lower end of rachis; the lowermost leaves placed laterally, and forming small transverse ridges very closely packed together. Fully developed leaves in upper third of rachis alternating with one another, and slightly overlapping along dorsal surface of rachis; not more than 2 millim. apart. Polypes 22 to 30 in number; the full number present in the immature leaves. Siphonozooids in single transverse rows at bases of leaves. Axis thick and rigid in rachis; upper end truncated and projecting beyond soft parts, or merely covered by thin skin; lower end tapering rapidly, entering the stalk, but not reaching the vesicle; axis oval in transverse section, and with the surface corrugated.

We have established this species for 15 specimens from the Mergui Archipelago. Nearly all these are perfect at their lower

\* Dr. Anderson informs us that this dark colour, amounting to blackness in some cases, is due entirely to the action of the spirit in which the specimens were preserved.

ends, but all show the truncation of the upper end of the rachis that is so characteristic a feature of the genus *Virgularia*.

The species approaches most closely to *V. Lovenii*, Kölliker, of which only a single fragment, from Port Jackson, Australia, has as yet been described\*.

In *V. Lovenii* the leaves are, however, much further apart (3-4 millim.) than in *V. prolifera* (1-2 millim.), and of smaller size; the autozooids also are less distinct from one another, and the siphonozooids are described and figured as arranged in irregular transverse rows, while in *V. prolifera* the rows are very regular. Kölliker's figures † of *V. Lovenii* are even more unlike our specimens than is his description, so that we feel fairly confident that the new species will prove to be a good one.

The principal measurements of four of our specimens, including the most divergent examples, are given in the following table:—

	<i>a.</i>	<i>b.</i>	<i>c.</i>	<i>d.</i>
Length of colony.....	243	165	170	263
Length of stalk.....	25	31	45	43
Length of rachis .....	218	134	125	220
Length of lateral zooid stripe of lower end of rachis .....	27	10	15	22
Length of rachis with immature leaves.....	110	63	65	116
Length of rachis with developed leaves.....	76	58	30	80
Length of upper end of rachis with small leaves .....	5	3	15	2
Greatest width of feather .....	6.5	7	5	12
Diam. of rachis in middle of length.	3	2.2	2.5	4.5
Diam. of stalk .....	4.7	4	5	6.5
Diam. of terminal vesicle .....	5	9	5	17
Diam. of axis, upper end.....	2×1.8	1.3×1.1	2×1.7	2×1.7
Number of immature leaves in lower part of rachis .....	200 circa.	150 circa.	150 circa.	220 circa.
Number of developed leaves .....	44	32	14	45
Number of small leaves at top of rachis.....	3	3	15	3
Greatest distance apart of leaves ...	2	2	1.5	2
Number of polypes per leaf .....	24	22	26	30
Height of largest leaf .....	2.5	3	1.3	4
Ventral border of largest leaf.....	2.2	3	1.2	5

\* Kölliker, *op. cit.* p. 201, and pl. xiii. figs. 121, 122.

† Kölliker, *op. cit.* pl. xiii. figs. 121, 122.

## Section IV. VERETILLEÆ.

## Family i. CAVERNULARIIDÆ.

Genus CAVERNULARIA, *Valenciennes*.

CAVERNULARIA OBESA, *Val.* (Plate XXIII. fig. 18.)

Of this variable species there are twelve specimens in the collection, all from the Andaman Islands.

The majority of these agree in all respects with the description given by Kölliker \*; two specimens, however, present special characters, and may be described as a distinct variety.

CAV. OBESA, var. *a*.

The two specimens in question, while agreeing in all essential respects with the typical form, are characterized by their very irregular shape. In one the stalk is absent, apparently cut off by the dredge. The rachis is cylindrical and of nearly uniform diameter in its lower three-fourths; the upper fourth is much narrower, and is separated by a marked constriction from the lower part, from which it projects somewhat obliquely as an irregular finger-like process.

The second specimen, which is drawn the natural size in fig. 18, is complete. The stalk is very short; the rachis, which is rather flabby in texture, expands from below upwards, and is produced at one side into a rounded terminal knob or bud. This knob appears to be the seat of most active growth, inasmuch as on it the polypes are smaller and much closer together than in other parts. The whole of the surface of the rachis between the polypes is covered, as usual in this species, with minute siphonozoids.

This irregular mode of growth, curiously like the budding of *Alcyonium*, is probably to be associated with the absence, in *Cavernularia obesa*, of the calcareous axis usually found in Pennatulida.

For the sake of comparison we give the principal measurements of some of the specimens, including those of the second example of var. *a*.

\* Kölliker, *op. cit.* pp. 338-343, and pl. xxii. figs. 199-201.

	<i>a.</i>	<i>b.</i>	<i>c.</i>	<i>d.</i>	<i>e.</i>	Var. <i>α.</i>
Length of colony.....	232	172	120	69	41	79
Length of stalk .....	44	39	27	19	9	13
Length of rachis .....	188	133	93	50	32	66
Diam. of rachis, greatest.....	38	35	40	20	13	25
Diam. of rachis, in middle.....	32	27	30	20	13	22
Diam. at junction of rachis and stalk .....	27	25	27	12	10	8
Average distance apart of polypes	1·5	1·5	1·5	1·8	1·6	2·5
Diam. of polype-mouths.....	0·7	0·5	0·7	0·8	0·5	1

## Family ii. LITUARIIDÆ.

Genus LITUARIA, *Valenciennes*.

LITUARIA PHALLOIDES, *Pallas*. (Plate XXIII. figs. 19–21.)

Of this species Kölliker\* notes that though it is probably widely distributed in the Indian Ocean, yet the actual number of recorded specimens is very small. Kölliker's description is drawn up from a single specimen in the Paris Museum from Sumatra, and during the voyage of the 'Challenger' a single example only was obtained, from Japan †.

In Dr. Anderson's collection there are eleven adult specimens, ten from the Andaman Islands, and one from the Mergui Archipelago, and nine young specimens from the Mergui Archipelago.

The adult specimens are all much alike; the majority are truncated at the upper end of the rachis, but two others are perfect, and bear small polypes at the extreme end. The specimens agree closely with the description given by Kölliker, the only points of difference of any moment that we have noted being the following:—

There is no line of boundary between the rachis and the stalk. The autozooids (polypes) extend lower down the rachis than the siphonozooids, but these lower ones are of very small size. There is in many specimens a very obvious plane of symmetry, the autozooids gradually increasing in size from the dorsal to the ventral surface. The siphonozooids do not cover the whole surface of the rachis between the autozooids, but are very distinctly arranged in rings around the latter. The cups

\* Kölliker, *op. cit.* pp. 313–316.

† Zool. Chall. Exp., Report on the Pennatulida, p. 32.



lodging the autozooids when retracted are black or dark brown. Finally the stalk is shorter relatively to the rachis than in Kölliker's specimen.

The single specimen from Mergui is rather paler in colour than the Andaman Islands examples, but agrees with these in other respects.

The axis in *Lituarina* (fig. 20) extends the whole length of the colony. In the stalk it is slender, and ends below in a flexible hooked extremity. Passing up into the rachis it gradually increases in size, being thickest at its upper end. Along the greater part of its length it is quadrilateral; wider from side to side than dorso-ventrally, and grooved longitudinally on all four faces. Its upper part presents laterally a number of cup-like depressions, lodging the deeper parts of the polype-cavities. These depressions, which increase in size and depth towards the top of the axis, are separated from one another by thin sharp-edged partitions, produced at places into prominent teeth (fig. 20), which during life come very close to the surface of the rachis.

In the young specimens (fig. 21), which vary in length from 13 to 19 millim., the fleshy cœnenchym of the rachis is very scanty, and the polypes few in number. The axis is very well developed, and its surface is deeply excavated to form cups for the lodgment of the polypes, the partitions between the cups coming quite to the surface, and forming a conspicuous mosaic pattern. The top of the rachis and axis is pointed, and the polypes are largest some little distance below it. In the smallest specimen there are 10 well-developed polypes, but no siphonozooids; in the largest of the nine there are about 20 polypes and a few siphonozooids in addition.

The principal dimensions of one of the adult specimens are as follows:—

Length of colony .....	145 mm.
Length of stalk .....	62
Length of rachis.....	83
Diam. of top of rachis .....	5
Diam. at junction of stalk and rachis ...	4
Diam. of stalk.....	3·5
Diam. of terminal vesicle .....	5

Genus *POLICELLA*, Gray.*POLICELLA MANILLENIS*, Kölliker.

Of this species there are two specimens; one from the Andaman Islands, the other from the Mergui Archipelago. The two differ a good deal in comparative firmness or flaccidity, in the varying degree of protrusion of the polypes, in colour, and in other secondary points. The figure given by Kölliker\* is, in many respects, intermediate between the two.

In the Andaman Islands specimen the whole cœnenchym is compact and firm; the axis is about three fourths the length of the colony; the autozooids are mostly in a state of complete retraction, and when expanded are smaller than in the other specimen. Along the lower 20 millim. of the rachis the autozooids are smaller, almost colourless, and arranged in longitudinal rows, separated by longitudinal folds of the cutis. The siphonozoids are exceedingly numerous, occupying the whole of the surface of the rachis between the autozooids, except in the lowest 20 millim., where they are absent. There are no calcareous spicules in the rachis, but small otolith-like bodies,  $0\cdot008 \times 0\cdot004$  millim., occur in considerable numbers in the deeper layers of the stalk.

The general colour of the rachis and stalk is yellow-ochre; the bodies of the autozooids are dark brown, paler at the base, and with yellowish-white tentacles.

In the specimen from the Mergui Archipelago the cœnenchym is much less firm, the rachis being soft and fleshy, and the stalk only slightly denser. The axis is shorter, hardly more than half the length of the colony, and more slender. The autozooids are larger, and are in a great many cases fully expanded; the transition from the fully-formed ones of the upper half of the rachis to the immature ones at its lower end is much more gradual than in the Andaman Islands specimen. The siphonozoids are smaller and less numerous, and are arranged in longitudinal rows between the autozooids. There are a few calcareous spicules in the cutis of the rachis, and numerous otolith-like bodies in the stalk.

The rachis and stalk are almost colourless; the autozooids are a dark purplish brown in their distal third, transparent at their bases, and have white tentacles.

\* Kölliker, *op. cit.* pl. xxii. fig. 189.

The principal dimensions of the two specimens are as follows :—

	Andaman Islands specimen.	Mergui specimen.
Length of colony .....	168	175
Length of stalk .....	48	37
Length of rachis .....	120	138
Length of axis .....	120	92
Diam. of stalk .....	17	7
Diam. of rachis .....	19	11
Diam. of axis .....	3.5 × 2.5	2 × 1.8
Length of largest autozoid .....	8-10	11
Diam. of largest autozoid .....	1.1	1.4
Tentacles of largest autozoid .....	2.6	4
Diam. of immature autozoid .....	0.64-0.5	0.54-0.4
Diam. of siphonozooids .....	0.4	0.16

*POLICELLA TENUIS*, sp. nov. (Plate XXIII. figs. 22, 23.)

Colony slender and of somewhat flabby consistency ; nearly uniform in width along its whole length, tapering slightly at both ends. Stalk slightly firmer than rachis, but not separated from it by a sharp line of demarcation. Axis rigid, less than half the length of the colony, quadrangular with rounded angles and slightly grooved sides. Polypes very long and slender, completely retractile, largest about the middle of the rachis, rudimentary at lower end of rachis. Siphonozooids covering whole surface of rachis between the polypes. A few small calcareous bodies in the rachis, and small otolith-like bodies in the stalk.

Of this form a single specimen was obtained from the Mergui Archipelago. The whole colony, including the polypes, is of an ashen-grey colour ; the rachis is soft, wrinkled, and its surface markedly slimy.

The axis extends about halfway down the stalk, and not quite halfway along the rachis.

The great length and slenderness of the polypes, the absence of any line of demarcation between rachis and stalk, the shortness of the axis, and the general flabby condition of the whole colony serve to distinguish the species at once from *P. manillense*.

The principal measurements of the specimen are as follows :—

Length of colony .....	252 mm.
Length of stalk .....	68
Length of rachis .....	184
Length of axis .....	110

Diam. of stalk .....	12 mm.
Diam. of rachis .....	13
Diam. of axis .....	4.5 × 4
Length of largest autozoid .....	12-14
Diam. of largest autozoid .....	0.8
Tentacles of largest autozoid.....	3.5
Diam. of immature autozoid .....	0.48
Diam. of siphonozoids.....	0.16-0.24
Length of calcareous bodies of rachis...	0.6
Diam. of otolith-like bodies of stalk ...	0.006

## DESCRIPTION OF THE PLATES.

In Figs. 5, 16, 20, and 22 the lower ends of the specimens have been drawn by the lithographer as bent up in an unnatural manner, in order to accommodate the figures to the size of the Plate. The specimens are naturally straight.

## PLATE XXII.

- Fig. 1. *Pterocides elegans*, latero-dorsal view, × 1.  
 2. *P. elegans*, leaf, under surface, × 3.  
 3. *P. Lacazii*, var.  $\alpha$ , leaf, under surface, × 1.  
 4. *P. Lacazii*, var.  $\beta$ , dorsal surface, × 1.  
 5. *P. Lacazii*, var.  $\beta$  with supernumerary leaves, ventral surface, × 1.  
 6. *P. Lacazii*, var.  $\beta$ , leaf, under surface, × 1.  
 7. *P. chinense*, var.  $\alpha$ , dorsal surface, × 1.  
 8. *P. chinense*, var.  $\alpha$ , ventral surface, × 1.  
 9. *P. chinense*, var.  $\alpha$ , leaf, under surface, × 1.

## PLATE XXIII.

- Fig. 10. *P. chinense*, var.  $\beta$ , dorsal surface, ×  $\frac{4}{5}$ .  
 11. *P. chinense*, var.  $\beta$ , leaf, under surface, ×  $\frac{4}{5}$ .  
 12. *P. Esperii*, var.  $\alpha$ , dorsal surface, ×  $\frac{4}{5}$ .  
 13. *P. Esperii*, var.  $\alpha$ , leaf, under surface, ×  $\frac{4}{5}$ .  
 14. *P. Esperii*, var.  $\beta$ , dorsal surface, ×  $\frac{4}{5}$ .  
 15. *P. Esperii*, var.  $\beta$ , leaf, under surface, ×  $\frac{4}{5}$ .  
 16. *Virgularia prolifera*, sp. nov., dorsal surface, × 1.  
 17. *V. prolifera*, sp. nov., leaf, × 3.  
 18. *Cavernularia obesa*, var.  $\alpha$ , ×  $\frac{4}{5}$ .  
 19. *Lituarina phalloides*, × 1.  
 20. *L. phalloides*, axis, × 1.  
 21. *L. phalloides*, young specimen, × 4.  
 22. *Policella tenuis*, sp. nov., × 1.  
 23. *P. tenuis*, sp. nov.: (a) Calcareous bodies from rachis, × 210; (b) Otolith-like bodies from stalk, × 210.



